



Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

THE RÔLE OF SERVICE IN EVOLUTION

BY PROFESSOR HERVEY WOODBURN SHIMER
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

SERVICE is an essential of life upon this earth. Compulsory it surely is in the vast majority of plants and animals, but it becomes more and more voluntary in the higher types of the invertebrate animals and finds finally its highest expression among the vertebrates in man.

When one organism is forced to yield its body for the nourishment of another it renders the grossest form of compulsory service. Yet all animals and many vegetable forms are dependent upon the death of other organisms for the prolongation of their own life.

“Life evermore is fed by death,
In earth and sea and sky;
And, that a rose may breathe its breath,
Something must die.

“The milk-haired heifer’s life must pass
That it may fill your own,
As passed the sweet life of the grass
She fed upon.”

To this compulsory service is due nearly all life upon earth and all opportunity for higher development. So that mere living rolls up the debt each individual owes to myriads of other individuals.

A higher type of compulsory service is seen in those organisms in which the production of young results in the death of the parent. This is the case in most herbs among plants and in many protozoons and insects among animals. Though the organism is compelled to perform this service, it lives its allotted span and then dies; death is not a tragedy. Compulsory service is also rendered by the individuals of one generation to those of the next in the furnishing of food for the developing embryo; the storage of nutriment around the germ in all higher plants, the provision of yolk for consumption within the shell or other envelope in the higher invertebrates and in all vertebrates, except the mammals, as well as the interuterine nourishment of embryonic mammals.

In the instinct, however, which furnishes food and protection to the growing offspring we have, coupled with an involuntary service, a certain amount of the voluntary indicated by variability among individuals of the same species in the amount and kind of labor they expend upon their young. This variability, increasing in the higher types of animals,

is an indication that some individuals are beginning to put a small amount of choice into this service. In the solitary wasps, typified by *Ammophila*, individuals of the same species differ greatly in the amount of food they furnish their young. Some are good providers, others poor. Some also are exact and precise in all their movements, others are very negligent and disorderly, leaving their offspring less effectively protected in numerous ways.

There is similarly a high degree of difference among individuals of the same species in the vertebrate line from fish up to man in the amount and efficiency of voluntary service to offspring. Some sunfish, for example, will fight courageously to protect their rude nests, others are very timid. Some birds, though trembling with fright, will continue to sit upon and protect their eggs even when threatened with death, while other individuals of the same species desert their eggs or young upon the least approach of danger. The lower races of man, likewise, show their inferior stage of development most forcibly in the insufficient food and care they give to wife and children.

As we glance backward over the history of the earth from the present Cenozoic Era, through the Mesozoic and Paleozoic, we see that compulsory service was ever present; that many millions of years ago in the lowest Paleozoic the grosser kinds alone existed; that gradually through the succeeding ages higher types of compulsory service appeared, existing side by side with the grosser; that, finally, voluntary service evolved, and, developing very slowly, reached a degree worthy of the name only in the Cenozoic. These various types of service continued to exist side by side; and since it was the more highly evolved plant or animal group that exhibited the correspondingly high type of service these occupied the better regions of the earth, forcing the less highly developed to less desirable habitats.

That the consumption of other organisms for the prolongation of one's own life extends from the present to the early periods of earth history not only the testimony of tooth structure, claws, tentacles and other food-capturing organs testify, but a multitude of actual records prove. Skeletons of marine reptiles (*Plesiosaurs*) are abundant in the Mesozoic era, which show in the region of the body where the stomach was formerly situated, the crushed cells of pelecypods and ammonites, the internal skeletons of squids and the broken bones of flying reptiles. In the living chamber of fossil cephalopods also occur at times the hard shell and scale remnants of the diet of these animals; these are found from the lower Paleozoic to the present. The appearance of fish scales in the living chamber of lower Paleozoic individuals testifies to the welcome they gave the earliest fishes upon this earth.

Besides this gross type of compulsory service there was present by

mid-Paleozoic time the forced yielding of the parent's life for the production of young. There were probably many protozoans of which this was true, as it undoubtedly was of many corals whose remains have been preserved, as well as of the many herb-like plants with a single growing season. It was, on the whole, the lower plant or animal groups only whose life span was thus reduced; to the higher groups a longer life was a necessity. Such higher individuals had been evolved by mid and upper Paleozoic time and these were compelled to prepare a considerable amount of nourishment for the developing embryo. This was true of the primitive seed-plants, as well as of the early fish, amphibians and reptiles.

If we may judge by the most nearly related living forms, there must likewise have been present during the entire Paleozoic a rudimentary kind of instinct, with but a minimum amount of free choice and hence of voluntary service. Even the insects, first appearing in the upper Paleozoic and rapidly becoming so numerous in the vast coal-swamps of that time, all belonged to the lower orders with a very low degree of instinct.

With the evolution in the Mesozoic era of the higher seed-plants, insects and fish, and of the most primitive birds and mammals, a higher type of compulsory service was initiated and a distinct beginning in voluntary service made. The higher seed-plants, typified by the oak and hickory, furnished a larger amount of embryonic nutriment and better seed protection than did the primitive seed-plants of the upper Paleozoic. The development of bees, ants and wasps with the mid-Mesozoic was most probably accompanied with a beginning of that wonderfully evolved instinct and of some voluntary service to their young, as well as to the members of the community, which characterize their modern representatives. The incoming at the same time of the highest order of fishes, the Teleostei, may likewise have been accompanied in some individuals, as it is in many of their living descendants, by a certain amount of voluntary service.

Some of the Mesozoic mammals, allied to the existing monotremes, probably like these laid eggs, hatched them as birds now do and then suckled the young; while others, more nearly related to the kangaroos and insectivores were, in all probability, like their modern representatives, forced to protect and nourish the embryo within the body until well developed and after birth to continue this care by fighting off enemies and nursing the young. While all the service before birth, and much after it, was compulsory there still remained a distinct amount of voluntary service both in hatching the eggs and in feeding and protecting the offspring.

During the Cenozoic appeared the highest forms of service, both

compulsory and voluntary, yet developed on the earth. The production of conspicuous flowers, of nectar and other devices for the perpetuation of species of plants is a form of compulsory service originating mostly during the Cenozoic, though undoubtedly some of these devices received their inception in the Mesozoic.

The development in the Cenozoic of the living groups of birds was accompanied, if it did not originate in the Mesozoic, with the hatching instinct. A considerable amount of this instinct is, however, voluntary service, since it differs so greatly among individuals of the same species or variety. After the young are hatched the parents are doubtless compelled by instinct to feed and protect them, but here again much of the service is without doubt voluntary. (Since the birds of the Mesozoic were reptile-like in the sharp teeth, claws upon the wings and long vertebrated tail possessed by most individuals, they may also have been reptile-like in their failure to personally hatch their eggs and feed and protect the young.)

The appearance of carnivore, rodent and hoofed mammals in the lower part of the Cenozoic initiated a much higher type of voluntary service. These mammals, to judge by their nearest living relatives, were compelled to serve their young before birth by interuterine nourishment and after birth through the secretion of milk. They also protected their young as well as their mates, and procured them solid food. They were doubtless impelled to these latter acts by instinct, but a considerable amount of voluntary service was present.

In the upper part of the Cenozoic appeared man, and with him began the development of the highest type of voluntary service yet evolved upon this earth. Slowly, extremely slowly, it advanced at first and was for long doubtless limited to the family; gradually, however, it was extended to other members of the clan, nation, language and finally even to the barbarian, heathen or gentile, and even to lower animals and to plants. Man is, however, still under the law of compulsory service. The unborn young must still be given interuterine nourishment and the young child food and care, while public opinion and man-made laws force the laggard to duties which he is not yet sufficiently evolved to perform voluntarily.

We thus see that the development of life upon this earth was due to mutual service, that without such service no higher forms of life could have evolved. Animals can live only through the death of other animals or of plants. Both animals and plants are compelled to give of their strength, or often of life itself, in the production of young. As animals and plants became more highly evolved they developed a higher type of service, that of furnishing more nourishment and better protection to their offspring. Very gradually, side by side with the higher kinds of

compulsory service, there was evolved a voluntary service; minute in kind and amount at first, it has finally come in the nobler members of mankind to dwarf the former by comparison into insignificance. Pre-Paleozoic time and the long Paleozoic era stand for low types of compulsory service; the Mesozoic for higher kinds of compulsory service with a definite beginning of voluntary service, while during the Cenozoic this latter type increased in amount until at present in man it far overshadows the service of compulsion.

Evolution as we see it upon this earth has thus occurred through each successively higher group, taking more and more from others, especially from parents, and giving more and more in return, especially to offspring; the service rendered is passed on, not returned. When, however, a plant or animal group takes more and more from others without giving additional service in return, we have parasitism, and parasites are not now, nor were they in the distant past, in evolving lines. Parasites whether plant, beast or human are degenerate; the individuals become weaker and weaker and finally the life ends in death.

The trend of evolution has thus been from compulsory service to voluntary, from an enforced aid to others to help given because of love for others. Those lives develop most rapidly and nobly which most nearly conform to this trend.